2. Write short answers to any Six (6) questions: 12

(i) State Hooke's law.

Ans The force is directly proportional to the change in length 'x' of the spring *i.e.*,

$$F = -kx$$

where x is the displacement of the mass from its mean position O, and k is a constant called the spring constant defined as

$$k = \frac{-F}{x}$$

The value of k is the measure of the stiffness of the spring.

(ii) What is meant by loudness of sound?

Ans Loudness is the characteristic of sound by which loud and faint sounds can be distinguished.

(iii) Calculate the frequency of a sound wave of speed 340 ms⁻¹ and wavelength 0.5 m.

Ans Given that;

Speed of waves $v = 340$ ms^{-1}
Wavelength $\lambda = 0.5$ m
Using the formula,

$$v = f\lambda$$

$$\Rightarrow \quad f = \frac{v}{\lambda}$$

$$f = \frac{340 \text{ ms}^{-1}}{0.5}$$

$$f = 680 \text{ Hz}$$

(iv) Write difference between noise and music.

Ans Some sounds which are pleasant to our ears are called musical sounds. *e.g.*, sounds of flute, harmonium, violin, drum, etc.

On the contrary, some sounds which have jarring and unpleasant effect on our ears is called noise. e.g., sounds of machinery, the slamming of a door, and sounds of traffic in big cities, etc.

(v) State the difference between concave and convex mirror.

Ans A spherical mirror whose inner curved surface is reflecting is called concave mirror while whose outer curved surface is reflecting is called convex mirror.

(vi) Define total internal reflection.

Ans When the angle of incidence becomes larger than the critical angle, no refraction occurs. The entire light is reflected back into the denser medium. This is known as total internal reflection of light.

(vii) What is prism?

Ans Prism is a transparent object (made of optical glass) with at least two polished plane faces inclined towards each other from which light is refracted.

(viii) How can be conductors and insulators identified with help of electroscope?

Ans Electroscope can be used to distinguish between insulators and conductors. Touch the disk of a charged electroscope with material under text. If the leaves collapse from their diverged position, the body would be a good conductor. If there is no change in the divergence of the leaves, it will show that the body under test is an insulator.

(ix) What is meant by point charge?

Ans Charges are said to be point charges if their sizes are very small as compared to the distance between their centres.

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3. Write short answers to any Five (5) questions: 10

(i) Write down two uses of capacitor.

Ans 1. They are used for tuning transistors, receivers and transistor radios.
2. They are used to distinguish between high and low frequency signals.

(ii)   What is difference between variable and fixed capacitor?

Ans In fixed capacitor, the value of capacitance is not changed. For example, paper capacitor and mica capacitor, etc.

On the other hand, in variable capacitor, the value of capacitance can be changed. That is, it can be increased or decreased. For example, capacitor is used in radio tuning circuits, etc.

(iii)   What is the function of voltmeter and ammeter?

Ans Voltmeter is an electrical instrument used to measure potential difference between two points in a circuit.

Ammeter is an electrical instrument which measures larger current.

(iv)   Define Ohm.

Ans When a potential difference of one volt is applied across the ends of a conductor and one ampere of current passes through it, then its resistance will be one ohm.

(v)   Prove that: $P = I^2 R$

Ans Electric power:

$$P = \frac{\text{Electrical Energy}}{\text{Time}}$$

$$P = \frac{W}{t}$$

Here, W (electric energy) is:

$$W = QV$$

By putting in the equation of 'P'

$$P = \frac{QV}{t}$$

$$P = \frac{ItV}{t} \qquad \qquad \therefore \quad Q = It$$

$$P = VI$$

$$P = I R I$$

Thus, it is proved that,

$$P = I^2R$$

(vi)   What is difference between live wire and neutral wire?

Ans The potential difference between live wire and neutral wire is 220 V.

(vii) What is the difference between D.C and A.C.?

Ans The current derived from a cell or a battery is direct current or D.C since it is unidirectional.

On the contrary, such a current that changes direction after equal intervals of time is called alternating current or A.C.

(viii) What is meant by intensity of magnetic field?

Ans The number of magnetic lines of force passing through any surface is called the intensity of magnetic field.

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4.   Write short answers to any Five (5) questions: 10

(i)   Write the principle of A.C. Generator.

Ans When a coil rotates in a magnetic field, the induced current in it continuously changes from maximum value and so on. This is the basic principle on which an A.C generator works.

(ii)   Define electronics.

Ans Electronics is that branch of applied physics which deals with the control of motion of electrons using different devices.

(iii)   Differentiate between analogue and digital electronics.

Ans The branch of electronics consisting of circuits which process analogue quantities is called analogue electronics.

On the other hand, the branch of electronics consisting of circuits which process digital quantities is called digital electronics.

(iv)   Define telecommunication.

Ans The methods and means that are used to communicate information to distant places instantly is called telecommunication.

(v)   What is Hard Disk?

Ans A hard disk is a rigid, magnetically sensitive disk that spins rapidly and continuously inside the computer chassis or in a separate box connected to the computer housing.

(vi)   What is Data Management?

Ans To collect all information regarding a subject to store them in the computer in more than one interlinked files which may help when needed, is called 'data management'.

(vii)   Define isotopes.

Ans Isotopes are atoms of an element which have same number of protons but different number of neutrons in their nuclei.

(viii)   Define penetrating power.

Ans The strength of radiations to penetrate a certain material is called penetrating power.

(Part-II)

NOTE: Attempt any Three (3) questions.

Q.5.(a) Derive an equation of relation between speed, frequency and wavelength. (4)

Ans Wave is a disturbance in a medium which travels from one place to another and hence has a specific velocity of travelling. This is called the velocity of wave which is defined by:

$$\text{Velocity} = \frac{\text{distance}}{\text{time}}$$

$$v = \frac{d}{t}$$

If time taken by the wave in moving from one point to another is equal to its time period T, then the distance covered by the wave will be equal to one wavelength λ, hence we can write:

$$v = \frac{\lambda}{T}$$

But time period T, is reciprocal of the frequency f, *i.e.,*

$$T = \frac{1}{f}$$

Therefore, $v = f\lambda$

The above equation shows the relationship between speed, frequency and wavelength.

(b) A sound wave has a frequency of 2 kHz and wavelength 35 cm. How much time will it take to travel 1.5 km.? (3)

Ans As given,

$$f = 2 \text{ kHz}$$
$$= 2000 \text{ Hz}$$

and $\lambda = 35$ cm
$$= 35 \times 10^{-2} \text{ m}$$
$$= 0.35 \text{ m}$$

and $d = 1.5$ km
$$= 1.5 \times 1000 \text{ m}$$
$$= \frac{15 \times 1000}{10}$$
$$= 1500 \text{ m}$$

So, $t = ?$

As we know that:

$$v = \frac{d}{t}$$

or $d = vt$

We find speed of sound wave:

$$v = f\lambda$$
$$v = (2000)(0.35)$$
$$\boxed{v = 700 \text{ m/s}}$$

To find time, we use the following relation:

$$t = \frac{d}{v}$$
$$t = \frac{1500}{700}$$
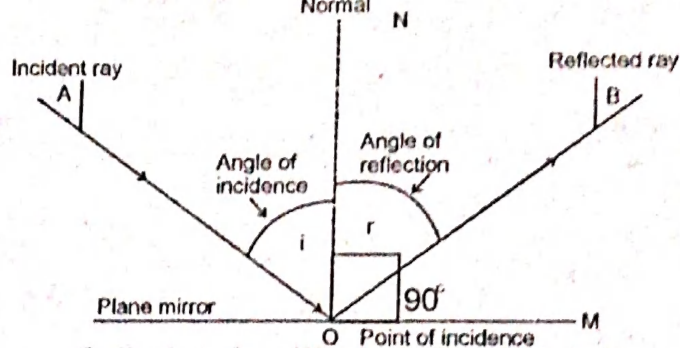$$\boxed{t = 2.1 \text{ sec}}$$

Q.6.(a) What do you understand by reflection of light? Draw a diagram to illustrate reflection at a plane surface. (4)

Ans **Reflection of light:**

The phenomenon of reflection is:

"When light travelling in a certain medium falls on the surface of another medium, a part of it turns back in the same medium."

Reflection of light is illustrated in the above figure. When a ray of light from air along the path AO falls on a plane mirror M, it is reflected along the path OB. The ray AO is called incident ray while the ray OB is called reflected ray. The angle between incident ray AO and normal N, *i.e.*, ∠AON is called the angle of incidence represented by 'i'. The angle between the normal and the reflected ray OB, *i.e.*, ∠NOB is called angle of reflection represented by r.

(b) Find the value of critical angle for water. If the refracted angle is 90°, the refractive index of water is 1.33 and that of air is 1. (3)

Ans When light enters the air from water, Snell's law becomes:

$$\frac{\sin r}{\sin i} = n$$

or $n \sin i = \sin r$

$n \sin i = \sin 90°$

$n \sin i = 1$

But $n = 1.33$

Thus, $i = \sin^{-1}\left(\frac{1}{n}\right)$

$i = \sin^{-1}\left(\frac{1}{1.33}\right)$

or $i = \sin^{-1}(0.752)$

$i = 48.8°$

So, critical angle of water is:

$c = 48.8°$

Q.7.(a) State and explain Coulomb's law. (4)

Ans For Answer see Paper 2015 (Group-I), Q.7.(a).

(b) The resistance of an electric bulb is 500 Ω. Find the power consumed by the bulb when a potential difference of 250 V is applied across its ends. **(3)**

Ans As given:

$$V = 250 \text{ V}$$
$$R = 500 \text{ Ω}$$
$$P = ?$$

According to Ohm's law:

$$V = IR$$
$$I = \frac{V}{R}$$

By putting the values:

$$I = \frac{250}{500}$$

$$\boxed{I = 0.5 \text{ A}}$$

Using power formula:

$$P = I^2R$$
$$= (0.5)^2 \times 500$$

$$\boxed{P = 125 \text{ W}}$$

Q.8.(a) What do you understand by digital and analogue quantities? (4)
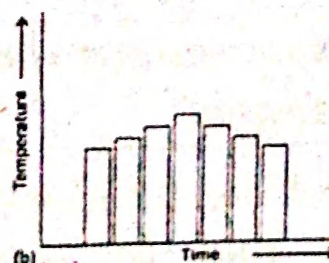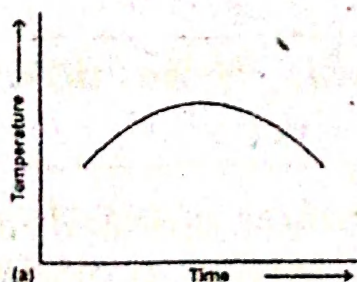
Ans **Analogue Quantities:**

The quantities whose values vary continuously or remain constant are known as analogue quantities.

Example:

Temperature, time, pressure, distance.

Explanation:

The temperature of air varies in a continuous fashion during 24 hours of a day. If we plot a graph between time and temperature recorded at different times, we get a following graph.

The above graph shows that temperature varies continuously with time. Therefore, we say that temperature is an analogue quantity.

Digital Quantities:

The quantities whose values vary in non-continuous manner are called digital quantities.

Explanation:

Digital version of analogue signal is shown in the following figure.

a) Analogue voltage signal t ⟶

b) Digital voltage signal t ⟶
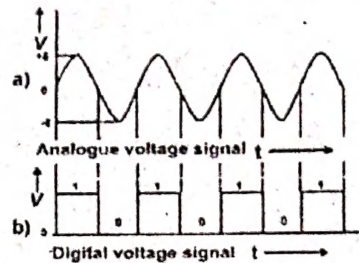
The above figure shows that digital quantities are expressed in the form of digits or numbers.

(b) A step-up transformer has a turn ratios of 1 : 100. An alternating supply of 20 V is connected across the primary coil. What is the secondary voltage? (3)

Ans **Given data:**

Voltage across primary coil = V_p = 20 V

No. of turns in primary coil = N_p = 1

No. of turns in secondary coil = N_s = 100

To find: Voltage across secondary coil = V_s = ?

Solution:
$$\frac{V_s}{V_p} = \frac{N_s}{N_p}$$

$$V_s = \frac{N_s}{N_p} \times V_p$$

$$= \frac{100}{1} \times 20$$

$$V_s = 2000 \text{ V}$$

Q.9.(a) Define electronic mail. Write down its three advantages. (4)

Ans One of the most widely used application of internet is electronic mail (or e-mail), which provides very fast

delivery of messages to any enabled site on the internet. Communication through e-mail is more quick and reliable. Through our e-mail, we can communicate with our friends and institution with more ease and pace.

Three advantages of e-mail are as follows:

Fast Communication:

We can send messages anywhere in the world instantly.

Cost free service:

If we have an internet access, then we can avail the e-mail service free of cost.

More efficient:

We can send our message to many friends or people only in one action.

**(b)   Define and explain the nuclear fusion reaction. (3)**


Ans   Nuclear fusion:

When two light nuclei combine to form a heavier nucleus, the process is called nuclear fusion.

Explanation:

The mass of the final nucleus is always less than the masses of the original nuclei. According to mass-energy relation, the loss of mass converts into an energy. If an atom of Deuterium is fused with an atom of Tritium, then a Helium nucleus or alpha particle is formed as given by:

$$_{1}^{2}H + _{1}^{3}H \longrightarrow _{2}^{4}He + _{0}^{1}n + energy$$
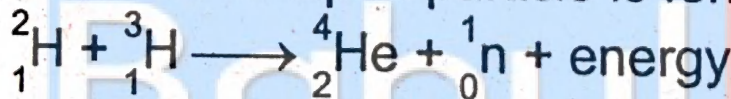
Nuclear fusion in Sun:
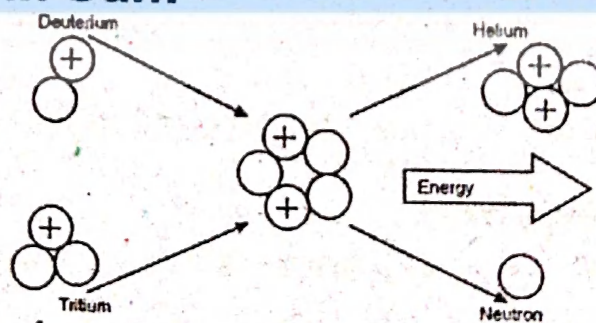
Energy coming from the Sun and stars is supposed to be the result of fusion of hydrogen nuclei into helium nucleus with release of energy. The temperature at the centre of the Sun is nearly 20 million kelvin which makes the fusion favourable. According to this reaction, four hydrogen nuclei fuse together to form a helium nucleus along with 25.7 MeV of energy.

(Part-III)

(Practical Part)

Note: Attempt any Two questions.

A-(i) Define critical angle. (3)

Ans "When a ray of light enters from denser medium to rarer medium then angle of incidence whose angle of refraction is 90° is called critical angle."

(ii) By using the following table, find the refractive index of glass: (2)

No. of obs.	< i	< r	Refractive index n = ?
1	37°	22°	
2	35°	20°	
3	36°	23°	

Ans

No. of obs.	< i	< r	Refractive index n
1	37°	22°	$\dfrac{\sin 37°}{\sin 22°} = 1.6065$
2	35°	20°	$\dfrac{\sin 35°}{\sin 20°} = 1.6770$
3	36°	23°	$\dfrac{\sin 36°}{\sin 23°} = 1.5043$

B-(i) Write the procedure for verification of Ohm's law.

Ans **Material required:**

Nichrome wire (of resistance not less than 10 Ω), voltmeter (0–15V), ammeter (0–0.06 A), rheostat (50 ohm), power supply (10 – 12 bV, 1A), key, connecting wires and sand paper.
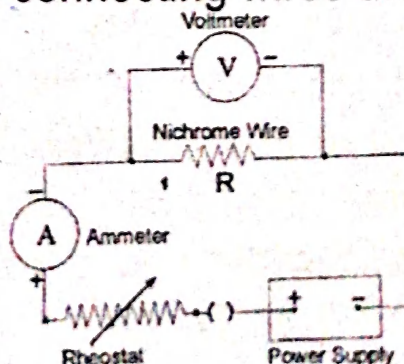
Procedure:

1. Draw the circuit diagram as shown in the above figure.
2. Make connections according to the circuit diagram. Nichrome wire is used as a conductor.
3. Before starting the experiment, bring the slider of the rheostat to its middle.
4. Turn the power supply ON. Slowly rotate its knob till the voltmeter shows a reading of 6 volts.
5. Close the key. A current should flow through the circuit as indicated by the ammeter.
6. Adjust the rheostat so that the current in the circuit remains within the range of ammeter.
7. Note the readings of voltmeter (V) and ammeter (I).
8. Determine the resistance R of nichrome wire for each reading by using the formula $R = \dfrac{V}{I}$.
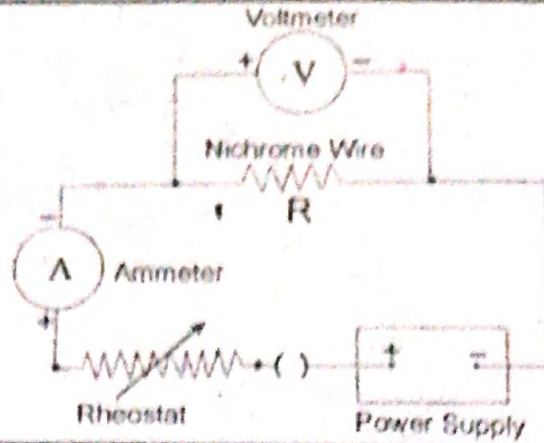
Readings:

No. of obs.	Voltmeter reading (V)	Ammeter reading I (A)	Resistance of conductor $(R = \dfrac{V}{I})$
1	2.0	0.1	20.0
2	3.0	0.15	20.0
3	4.0	0.20	20.0
4	5.0	0.25	20.0
5	6.0	0.30	20.0

(ii) Draw the circuit diagram for Ohm's law.   (2)

Ans The circuit diagram for ohm's law is given below:

Voltmeter — V
Nichrome Wire — R
A — Ammeter
Rheostat
Power Supply

C-(i) What is "AND Gate"? Write its equation also. (3)

Ans The circuit which implements the AND operation is known as AND gate.

The equation of AND Gate is:
$$X = A.B$$

(ii) Verify the truth table of "AND Gate". (2)

Ans Truth Table:

The truth table of AND gate is given below:

S_1	S_2	Lamp
Open	Open	OFF
Open	Closed	OFF
Closed	Open	OFF
Closed	Closed	ON

Verification:

Here,
$$OFF = 0$$
$$ON = 1$$

So,

X = A.B	B	A
0	0	0
0	1	0
0	0	1
1	1	1

After reading above table from left to right the truth table of 'AND Gate' can be explained.